Between a Rock and a Hard Place - Options for Using Ceramic Membranes to Reduce DBP Formation

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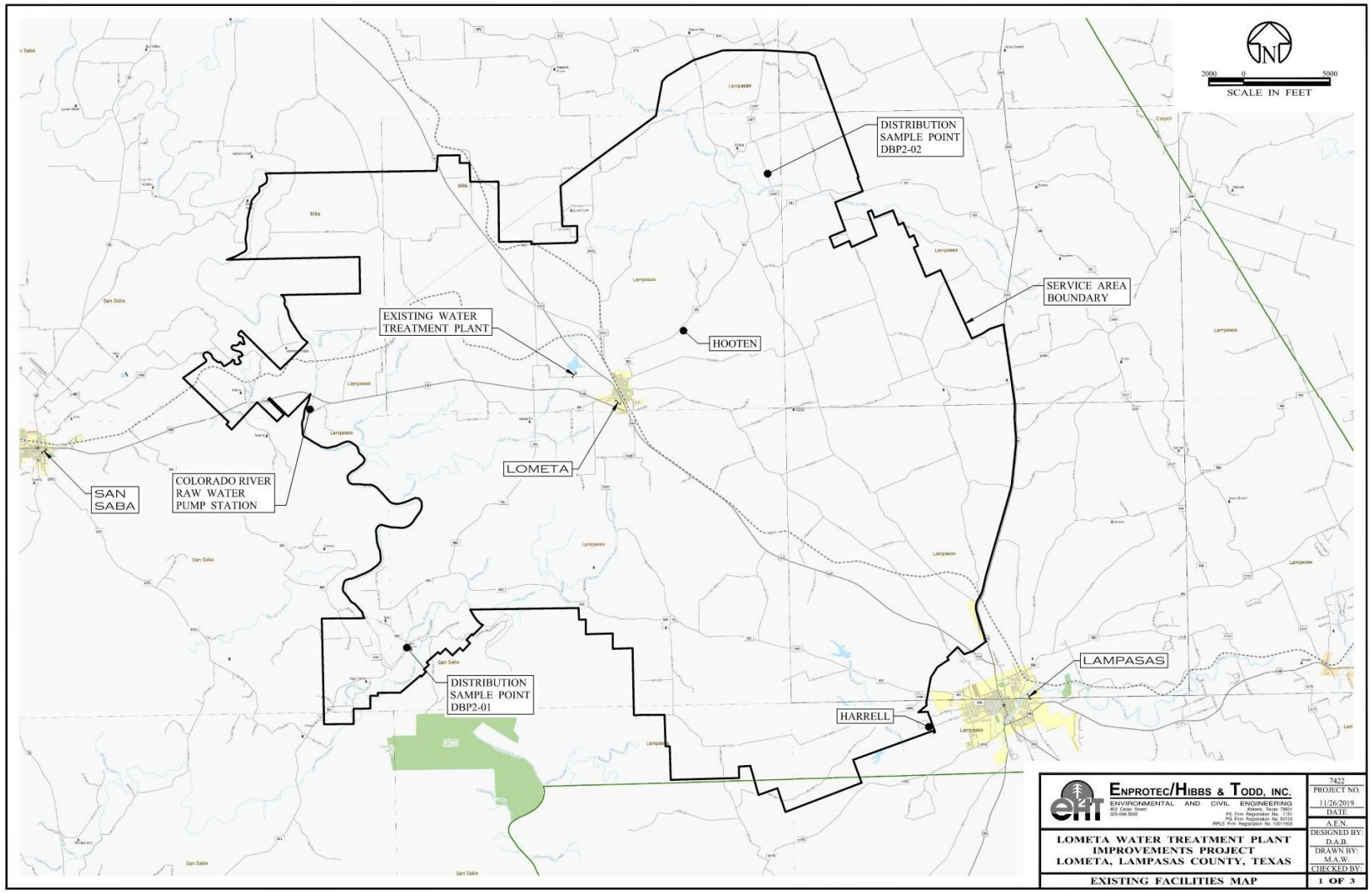
Presentation Topics

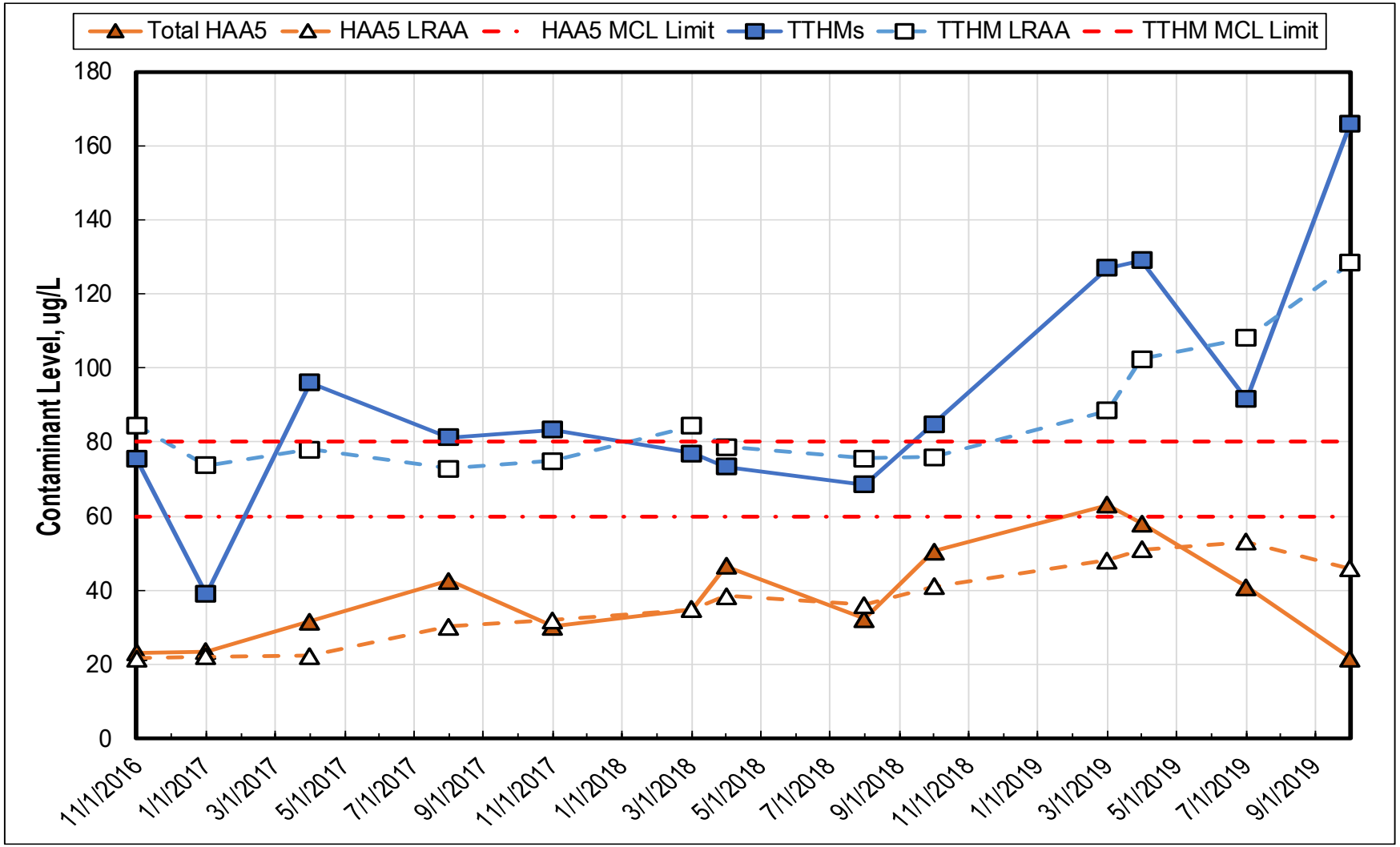
- Background on Lometa Water System
- Historical DBP Challenges
- Treatment Options Considered
- Ceramic Membrane Filter Pilot Testing Observations
- Treatment Path Forward
- Next Steps

Background on Lometa Water System



Background on Lometa Water System

Historical DBP Challenges



Treatment Options Considered

Reduce DBP Formation Potential?

- Reduce TOC
- Reduce Bromide

Reduced Formed DBPs?

- Reduce formed TTHMs
- Reduce Formed HAA5

Treatment Options Considered

Reduce DBP Formation Potential?

- Reduce TOC via strong oxidant use
- Reduce TOC via enhanced coagulation
- Reduce TOC via MF/UF filtration
- Reduce TOC/Bromide via NF/RO treatment

Treatment Options Considered

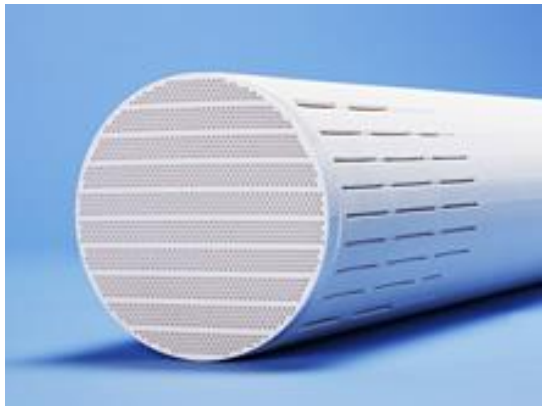
Reduce Formed DBPs?

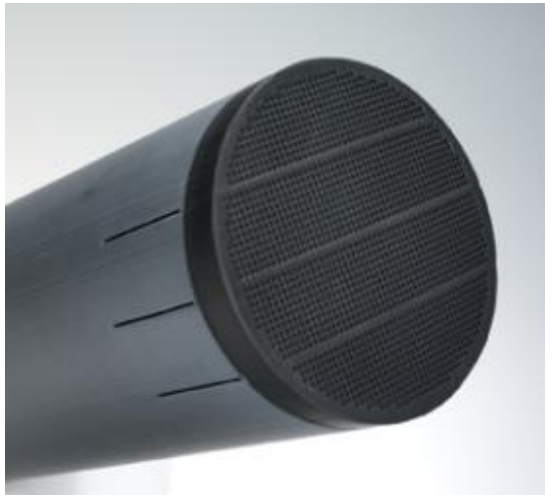
- Reduce formed DBPs via RO
- Strip formed DBPs via in-tank aeration
- Strip formed DBPs via aeration towers

Treatment Options Considered

Membrane Filtration Options

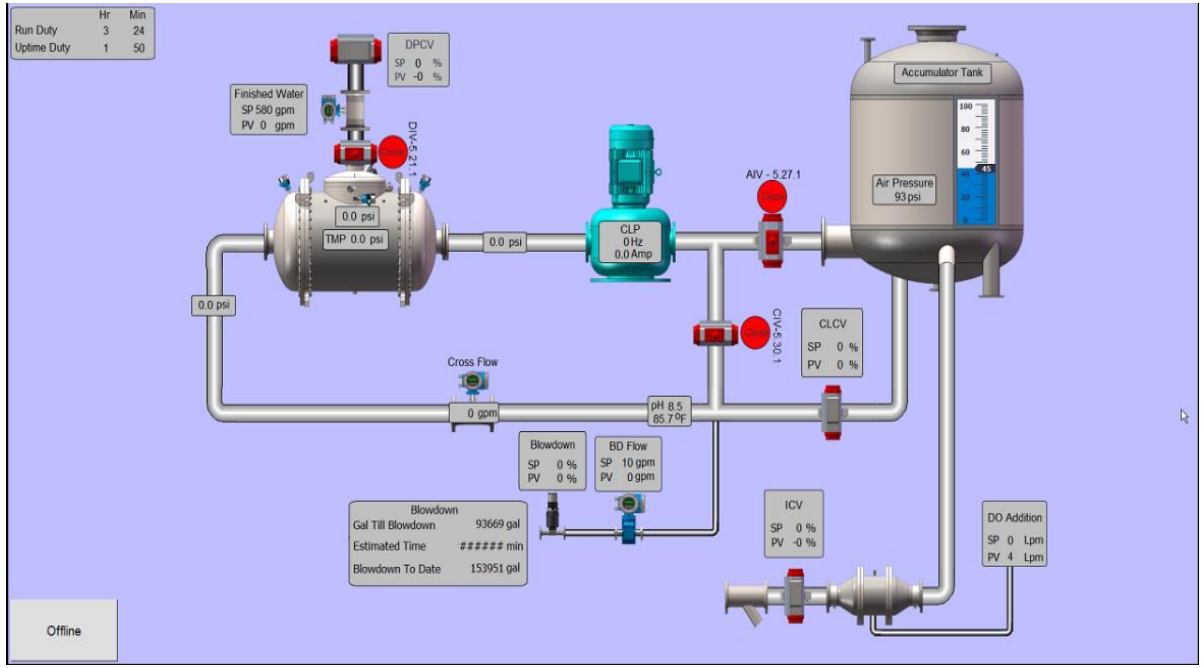
- Consideration of Ceramic Options
  - "First Generation" Polymeric Membranes
    - Direct Filtration Flux – 30-60 gfd
    - CT log removal ~ 3-log LRV
    - Membrane Life – 8-10 yrs
    - TOC Reduction – 30-50%



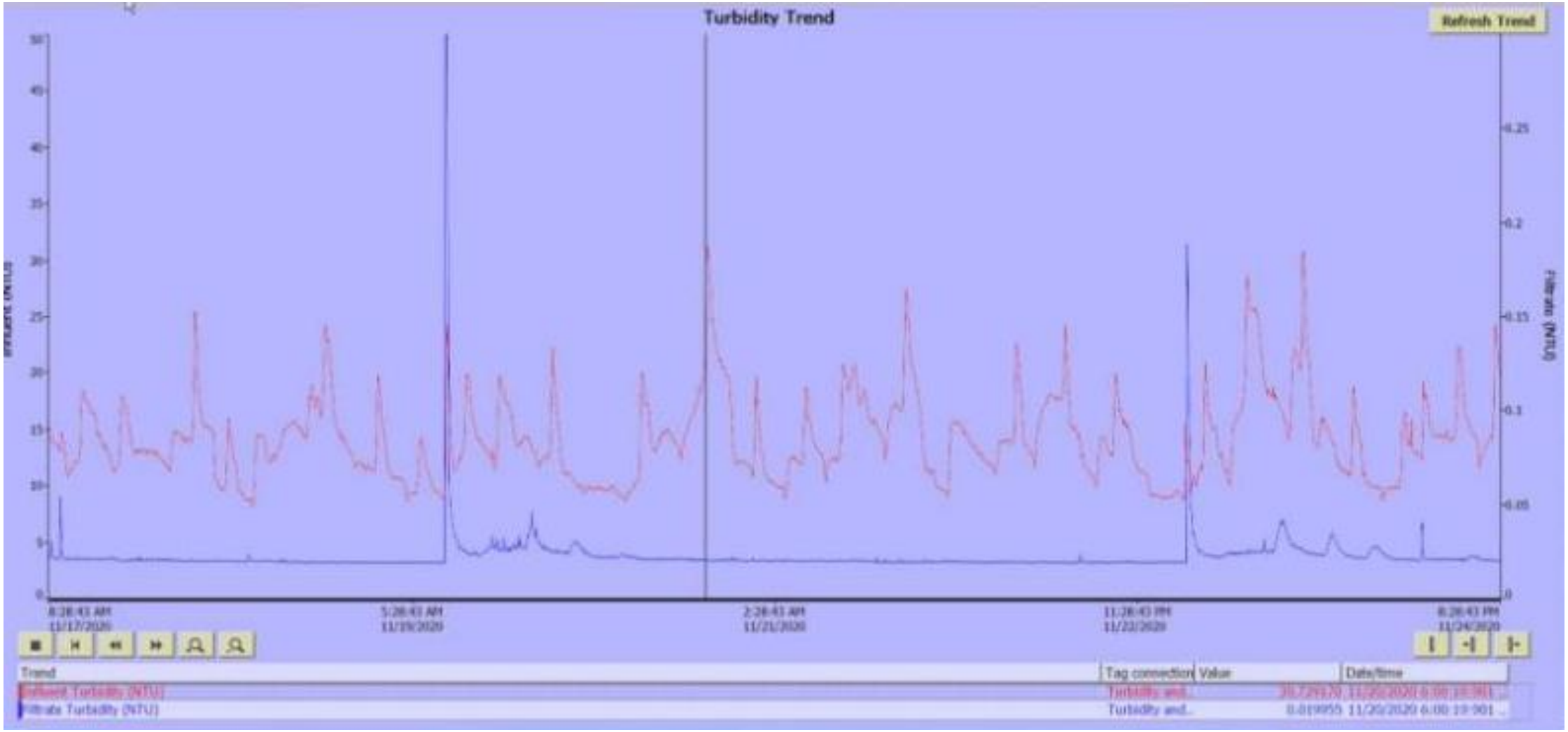


  - "Second Generation" Ceramic Membranes
    - Direct Filtration Flux – 100-250 gfd
    - CT log removal ~ 5-6.5-log LRV
    - Membrane Life – 20+ yrs
    - TOC Reduction - ??

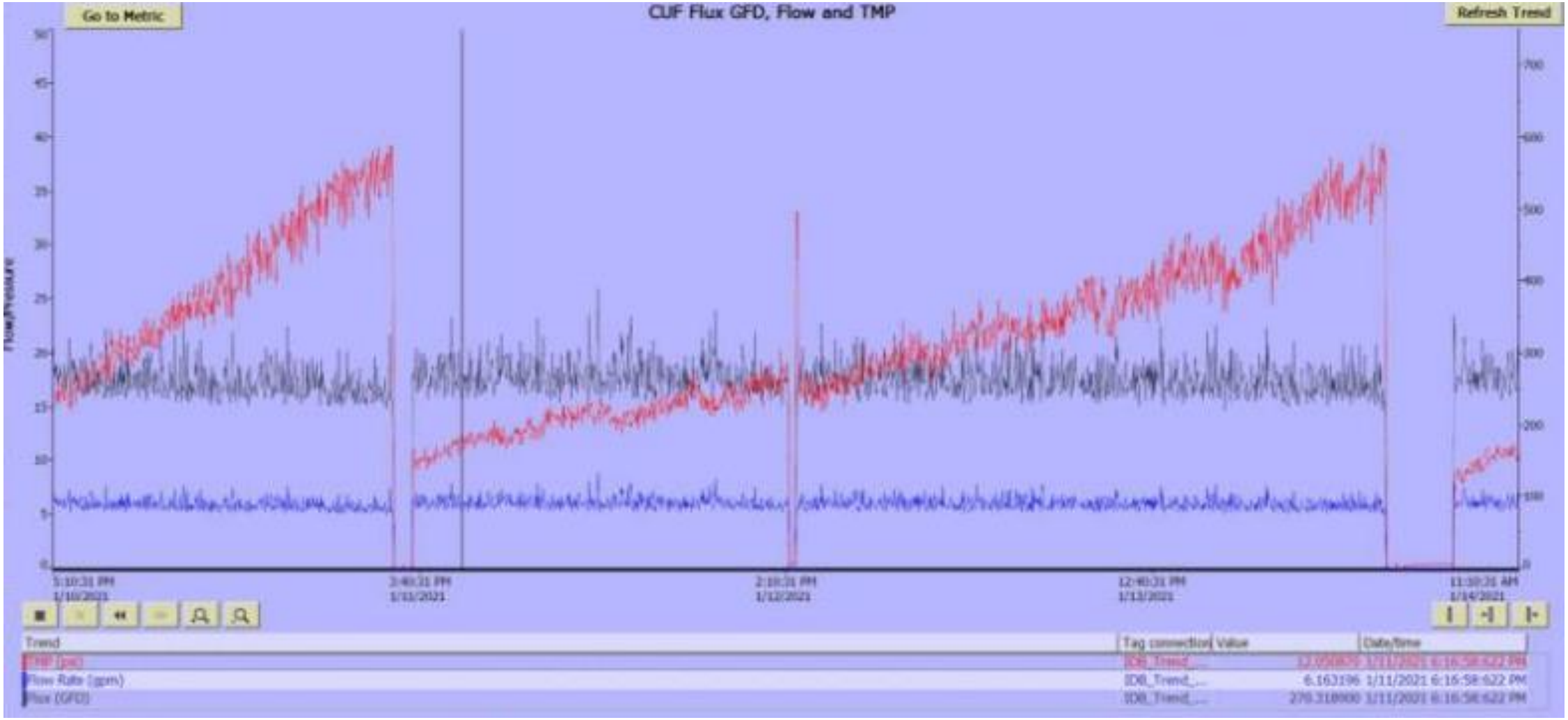
Ceramic Membrane Filter Pilot Observations



Ceramic Membrane Filter Pilot Observations



Ceramic Membrane Filter Pilot Observations



Ceramic Membrane Filter Pilot Observations

Parameter / Sample Date	10/23/20	10/29/20	11/05/20	11/12/20	11/19/20	11/25/20	12/10/2020	12/17/2020
CUF Hypo Dose (ppm)	3	3	3	1.5	1.5	1.5	0	0
Post CUF Free Cl2 (ppm)	0	0	0	0	0	0	1.5	2.2
Raw TOC	6.2	6.39	5.91	6.31	5.68	6.19	5.9	5.8
Finished TOC	3.18	3.35	3.15	3.3	3.26	3.48	3.2	3.39
TOC Removal (%)	48.7%	47.6%	46.7%	47.7%	42.6%	43.8%	45.8%	41.6%
HAAs								
Bromoacetic Acid	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloroacetic Acid	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dibromoacetic Acid	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dichloroacetic Acid	0.0212	0.0216	0.0148	0.0327	0.0293	0.0239	0.0163	0.0083
Trichloroacetic Acid	<0.005	0.0164	<0.005	0.0399	0.0249	0.0168	0.0131	<0.005
Total HAAs	0.0212	0.038	0.0148	0.076	0.0542	0.0407	0.0294	0.0083
THMs								
Bromodichloromethane	0.0144	0.024	0.0125	0.0115	0.0313	0.0173	0.00289	0.00431
Bromoform	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroform	0.0545	0.057	0.0453	0.039	0.0901	0.0524	0.00626	0.00815
Dibromochloromethane	0.00209	0.00527	0.00194	0.00248	0.0102	0.00805	0.00145	0.0021
Total THMs	0.07099	0.08627	0.05974	0.05298	0.1316	0.07775	0.01059	0.01456
Total Iron	<0.00379	<0.00379	<0.00524	<0.00379	0.0116	0.00518	0.005	<0.00379
Total Manganese	NS	<0.00033	0.000478	0.00033	0.000783	0.000983	0.001	0.000926

Ceramic Membrane Filter Pilot Observations

Sample	Feb. 2021 Free Chlorine – TTHM (ug/L)	Mar. 2021 Free Chlorine – TTHM (ug/L)	Mar. 2021 Free Chlorine – HAA5 (ug/L)	Mar. 2021 Total Chlorine – TTHM (ug/L)	Mar. 2021 Total Chlorine – HAA5 (ug/L)
Initial Dosing	20.1	26.2	5.5	10.8	5.0
Day 1	84.5	92.3	14.3	13.8	8.7
Day 3	110.7	134.9	21.7	11.3	8.3
Day 5	113.7	147.2	29.0	14.2	10.9
Day 7	104.7	-	-	-	-

Treatment Path Forward

- Ceramic MF/UF did not reduce DBP formation potential enough to allow transition to free chlorine in distribution
- Use of ceramic MF/UF with optimized coagulation can reduce TOC by 40-50%
- Need to test chlorine dioxide efficacy on raw water – goal to increase TOC reduction to 70+%
- Field testing to enhance use of DBP stripping at WTP and in distribution system

Next Steps

- Begin design of membrane filtration system
- Lab-/bench-scale testing for potential use of strong oxidant
- Begin design of DBP stripping systems (both in-tank and external systems)
- Commissioning and performance testing of new treatment systems

Questions?